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OPERATING MANUAL

Power supply units for voice alarm systems (VAS)
type
ZDSO500-DR2 and ZDSO500-DR3

complies with EN 54-4
Certificate of constancy of performance no. 1438-CPR-0922
Declaration of performance DWU-MX-21

06.02.2023

Warnings

- Please read this operating manual carefully before operating the device.
- Do not touch internal components of the operating device - risk of shock or burns.
- Protect any objects or liquids from entering the device - risk of shock and damage to the device.
- Do not cover the ventilation openings - risk of damaging the device.
- The device must be supplied from the mains with a protective earthing terminal.
- The device may interfere with sensitive radio and television equipment in the vicinity.
- Particular attention should be paid to the connection of the battery terminals; reverse connection of the battery poles will damage the power supply unit (PSU).
- The device may only be serviced by the manufacturer's service team or specialized units authorized by the manufacturer.
- Only authorized, trained and qualified personnel may operate the device.
- The device is designed to work with external high-capacity battery bank. Particular attention should be paid to the dangers of their weight and the possibility of fire or explosion if the storage battery leads are short-circuited.

1. General description and purpose

ZDSO500-DR PSUs are designed for use in voice alarm systems (VAS). They act as a charger and monitoring system for external battery banks with guaranteed voltage of 24V, in accordance with EN 54-4. Their primary function is to provide redundancy power supply for the VAS power amplifiers in the event of a mains power failure (the amplifiers must have their own mains power supply). Moreover, PSUs can provide continuous power supply from the main (mains) or backup source to those components of the VAS that are only adapted to 24V DC.

The two types of PSUs have similar enclosures designed for mounting in a typical 19-inch rack cabinet. ZDSO500-DR3 PSU, with a height of 2U, has an increased number of outputs for power amplifiers and auxiliary outputs and allows operation with three battery banks.

This design allows flexible selection of PSUs according to the requirements of the VAS in question: the number of battery banks, the number of outputs for amplifiers and auxiliary outputs. The basic design features are shown in the table below.

	ZDSO500-DR2	**ZDSO500-DR3**
19" chassis height	1U	2U
Number of main outputs for power amplifiers **Out** 75A	3	5
Number of main outputs for power amplifiers **Out** 40A	3	6
Number of auxiliary **Aux** outputs	4	8
Number of inputs for redundancy power supply batteries	2	3

The following is supplied along with PSU:

- two 1.5m long temperature sensors with their own plugs;
- a set of plugs for connecting the PSU to the VAS amplifiers via the **Out** outputs;
- a set of plugs for the connection of the PSU to continuous operation equipment via **Aux** outputs ;
- a set of 3 plugs for connecting relay indication outputs;
- a plug for connecting an external fault indication input with a pre-mounted jumper;
- a plug for the voltage equalization system for battery bank (so-called balancer).

For a detailed description of the plugs, see section 8.2.

Fig.1. View of the front and rear panels of ZDSO500-DR PSU

The front panel of the PSUs features a set of 4 indicator LEDs, a multifunction **ST** button and a USB digital communication connector socket (type B).

The individual indicator LEDs have the following designations:

Mains	green color	**Charging**	green color
Battery	yellow color	**Fault**	yellow color

Functions of the **ST** button include:

- starting the PSU only from batteries, without mains power supply (so-called cold start);
- pressing the button for 1 second: an attempt to delete the error displayed by the **Fault** LED. Failure to respond is indicative of serious damage to the PSU .
- pressing the button for 5 seconds:
  - inclusion of USB communication capability. If there is no exchange of information for 20 seconds, this possibility is switched off;
  - traffic light test by illuminating all LEDs.

The components on the rear panel of the PSU are summarized in the table below. The last column contains references to sections in this manual with a detailed description.

Components on the rear panel

Designation	Function	Description under
Bat	M8 pin terminals for connecting the battery bank.	8.6.
Out	High-current outputs with internal safety fuses and LED indication of their blowing, to supply power to amplifiers.	8.4.

Aux	Guaranteed voltage outputs with internal safety fuses and LED indication of their blowing.	8.5.
Temp sensor	Two sockets for connecting temperature sensors.	8.10.
Bat fault	Three relay indication outputs with available changeover contacts.	8.9.
Gen fault		
Mains fault		
Ext fault	External fault signal input and LED.	8.8.
Ethernet	Ethernet connector socket (optional).	9.3.
Battery Cap	Battery bank capacity selection switch.	7.5.
Battery Ri	Switch for the selection of maximum battery circuit resistance.	
SRV	Button for activating service functions.	9.6.
230Vac ...	Mains connector.	8.3.

A detailed description of the operating status indication relating to both the front and rear panel is given in section 9.4.

For details of the connectors used, see section 8.2. of this manual and for information on the fuses used, see section 9.6.

2. Electrical parameters

A summary of the basic electrical parameters is given in the table below.

Basic electrical parameters

	ZDSO500-DR2	**ZDSO500-DR3**
Mains power supply		
Nominal supply voltage	230/115V 50/60Hz	
Supply voltage range *1)	80...264V	
Maximum supply current	2.9/5.8A	5.8/11.6A
Power factor	PF> 0.94/0.98	
Leakage current in the protective conductor at 240V	≤ 0.75mA	≤ 1.5mA
Output parameters		
Maximum load current of the **Out** outputs	3× 75 A 3× 40 A	5× 75 A 6× 40 A
Maximum number and power of amplifiers	3× 2000W 3× 1000W	5× 2000W 6× 1000W
Overcurrent protection on **Aux** outputs	2× 8 A 2× 4 A	4× 8 A 4× 4 A
Maximum total load capacity of **Aux** outputs *2)	15 A	2× 15 A
Output voltage variation range *3)	19.5...28.8V	
Ripple voltage at **Out** and **Aux** outputs	< 150mV$_{PP}$	
Imax_a / Imax_b according to EN 54-4	see section 7.2. and Fig. 5.	
Cooperation with batteries		
Rated battery voltage	24V	
Maximum number of battery banks	2	3
Floating operation voltage at 25°C	27.1V	
Bulk charging voltage at temp. 25°C	27.8V	
Disconnection voltage of a discharged battery	20.4V	
Temperature coefficient for voltages	-40mV/°C	
Maximum total capacity of external battery 230V/115V *4)	400/350 Ah	810/720 Ah
Maximum charging current 230V/115V *5)	18/15 A	36/30 A

Max. resistance of a single battery circuit	10...65 mΩ *6)	
Max. load current of a single battery bank	200A	
Current consumption from the battery for the PSU – with RGR connected – with RGR connected and fans on – after disconnection of the RGR	 180 mA 300 mA 0.4 mA	 245 mA 295 mA 0.4 mA
Other		
Relay indication outputs – galvanic isolation – available contacts – load capacity	 yes NO, NC 30V/2A at resistive load	
Fault signal input – galvanic isolation – load (while active) – resistance to external voltage	 no *7) +5V/1.5mA +100V/-1V	

*1) The available output power may be limited when the power supply is lower than 115V and the internal temperature of the PSU is higher than 50°C. This affects the available current from the **Aux** outputs.*

*2) ZDSO500-DR3 PSU has two independent **Aux** output sets (see section 8.5.)*

3) The range shown is between the voltage of the discharged battery bank (at the end of the battery mode) and the bulk charging voltage including temperature compensation.

*4) Assuming no current is drawn from the **Aux** outputs. Loading the **Aux** outputs reduces the available maximum capacity of the battery bank (see section 7.2.).*

5) The specific value depends on the selected capacity of the battery bank (see section 7.4.).

6) The specific value within the specified range can be set to within 5mΩ using the slide switch for selecting the maximum resistance of a single battery circuit.

7) The input is connected to the negative bus of the PSU output voltage.

Voltage strength of circuits

Input circuits (mains) – other output circuits *) – enclosure	 4200Vdc 2800Vdc
Output circuits (24V outputs, battery bank) – enclosure	 710Vdc
Relay indication circuits – output circuits – enclosure	 710Vdc 710Vdc
Digital Ethernet communication circuits (if used) – output circuits – enclosure	 2100Vdc 2100Vdc

**) The figure given is the insulation resistance test level and not the voltage test level between the indicated circuits. Such a test can only be performed under special conditions and not on a complete, assembled product.*

Attention.

The USB digital communication connector is galvanically connected to the PSU enclosure (PE line of the mains power supply) and at the same time is isolated from the other PSU circuits.

Compliance with standards

Electrical safety	EN 62368-1:2020 + A11:2020 class I
Functionality	EN 54-4:1997 + AC:1999 + A1:2002 + A2:2006
EMC immunity	EN 50130-4:2012 + A1:2015
EMC emission	EN IEC 61000-3-2:2019 + A1:2021 EN 61000-3-3:2013+A1:2019+A2:2022 EN IEC 61000-6-3:2021

PSU meets the requirements of Regulation (EU) no. 305/2011 of the European Parliament and of the Council of 9 March 2011 (CPR - Construction Products Regulation).

3. Mechanical and environmental parameters.

ZDSO500-DR PSUs have metal enclosures in the form of cassettes designed for installation in a typical 19-inch rack. Meeting the requirements of EN 54-4 requires that the rack in which the VAS is installed has an IP30 protection level.

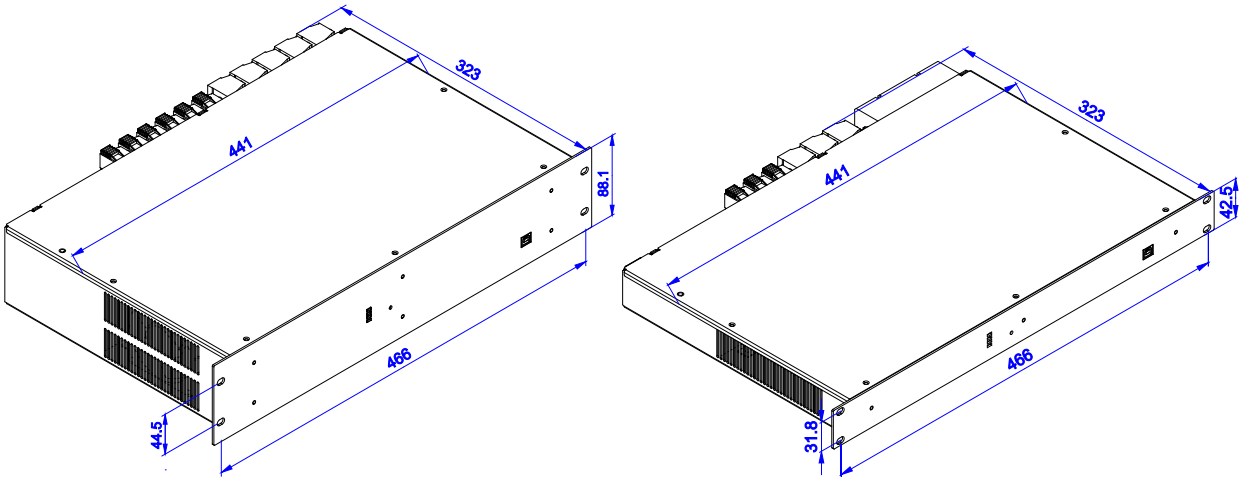


Fig.2. View and overall dimensions of ZDSO500-DR3 and ZDSO500-DR2 PSUs.

Mechanical and environmental parameters

Mechanical parameters	
Overall dimensions (W x H x D) ZDSO500-DR2 ZDSO500-DR3	 483(19") × 42.5(1U) × 323 mm 483(19") × 88.1(2U) × 323 mm
Mounting holes on the front panel ZDSO500-DR2 ZDSO500-DR3	 466 × 31.8 (5/4”) mm 466 × 44.5 (1 and 3/4”) mm
Rack installation depth (including connectors)*	323 mm
Degree of protection	IP20
Weight ZDSO500-DR2 ZDSO500-DR3	 5.4 kg 8.0 kg
Environmental parameters	
Operating temperature range (class 3K5 according to EN 60721-3-3)	-5....45°C
Cooling	internal, forced
Storage temperature	-40....85°C
Relative humidity	max 90%
Direct sunlight	unacceptable
Impact during operation	unacceptable

* this dimension does not include a margin for wiring protruding beyond the connector

4. Operating principle

Simplified PSU diagrams are shown below in Figures 3 and 4. ZDSO500-DR2 PSU is a structurally simplified version of ZDSO500-DR3 PSU.

The PSU system is based on a so-called direct floating mode. The mains rectifiers (**RECTIFIERS**), which also act as a charger, are connected in parallel to the outputs **Out** and **Aux** and to the external battery bank **BAT**. With the mains supply present, the rectifiers supply current to the load at outputs **Aux** and charge the battery at the same time. In this state, **Out** outputs cannot be loaded. The connected power acoustic amplifiers must have their own mains power supply.

In the event of a mains power failure, the load is automatically taken over by the battery. In this state, it is also possible for the VAS amplifiers to draw current from the **Out** outputs.

Protection of the battery bank against deep discharge is provided by the low voltage disconnect device **LVDD**. The battery disconnect **BD** devices ensure that the voltage is maintained at the **Aux** outputs in the event of a short circuit of the battery terminals. This is a requirement of EN 54-4.

All outputs use safety fuses which are located inside the PSU. They can be replaced by unscrewing the PSU top cover. The **Out** output fuses additionally need to be unscrewed with a 4mm allen key. The fuses at the **Aux** outputs have their own holders to simplify replacement. Each output has its own fuse; in addition, each set of 4 **Aux** outputs is protected by a single fuse which limits the total current that can be drawn from these outputs.

ZDSO500-DR PSUs are equipped with several systems for current measurement: on each battery output, on each rectifier and on each set of 4 **Aux** outputs. This makes it possible to control the battery charging current, the load current of the **Aux** outputs and to detect the current at the **Out** outputs when mains power supply is present. In the latter case, it is possible to trigger an alarm indicating that one of the VAS amplifiers is unplugged or its mains power supply system is faulty.

Two more special sub-systems are used in the PSU system: an RMS unit to measure the resistance of each battery circuit (this is an EN 54-4 requirement) and a voltage equalization system for battery bank **BATTERY BALANCER**. The latter is an accessory designed to prolong battery life by preventing the appearance of excessive voltage differences between batteries. Its use is optional.

Despite the designation of individual outputs of the balancers to specific batteries, such a specific connection is not necessary. The system also tolerates the accidental connection of these outputs to any pole of any battery bank of the ZDSO500-DR PSU. A **Bm** fuse is required near the battery on each output to protect the connection cable in case of insulation damage and accidental short-circuit.

Attention.

It is imperative that the system uses a **Ba** battery fuse located near the positive terminal of the battery bank to protect the battery and its connections from the effects of a short circuit. The size of the fuse should depend on the maximum current load that can occur in the system.

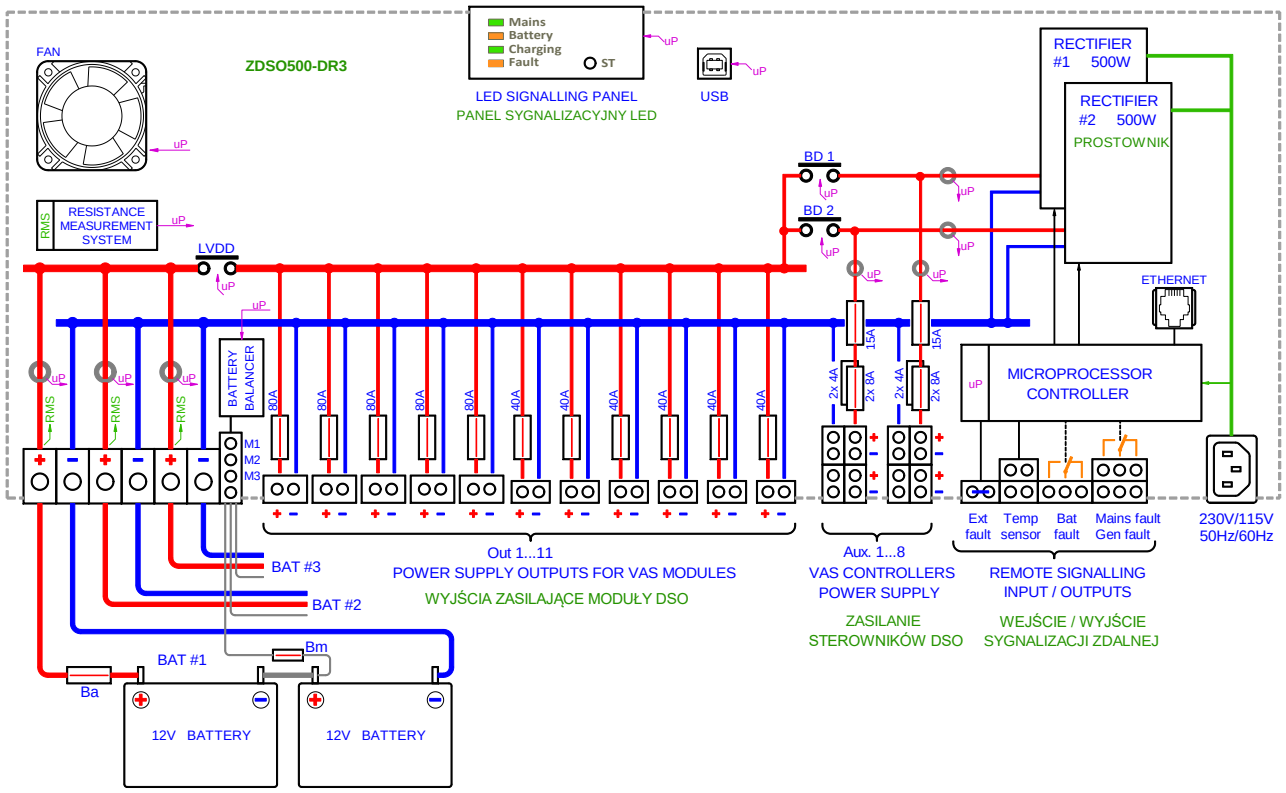


Fig. 3. Simplified diagram of ZDSO500-DR3 PSU.

The operation of the entire ZDSO500-DR PSU is managed by a microprocessor controller μ**P**. Its basic tasks include:

- making internal measurements of voltages and currents, including mains power supply voltage, necessary for the operation of the PSU;
- control of the rectifiers (**RECTIFIERS**) to ensure the correct charging and operating conditions of the battery bank;
- measuring the temperature of the battery bank and the ambient temperature (**Temp sensor**);
- control of fault indication relays (**Bat fault**, **Mains fault** and **Gen fault**) and acceptance of an external fault signal (**Ext fault**);
- control of the LED indication on the front panel of the PSU (**LED SIGNALLING PANEL**) and operation of the **ST** button located there;
- adopting the settings of the battery capacity selection switch (**Cap**) and the switch for the selection of battery circuit maximum resistance (**Ri**) and the function button (**SRV**). These components, located on the rear panel of the PSU, are not included in the diagram;
- control of the battery circuit resistance measurement system (**RMS**), the voltage equalization system for battery bank (**BATTERY BALANCER**) and cooling fans for PSU interior (**FAN**);
- support of digital communication via a USB port on the front panel of the PSU and an optional **ETHERNET** link on the rear panel.

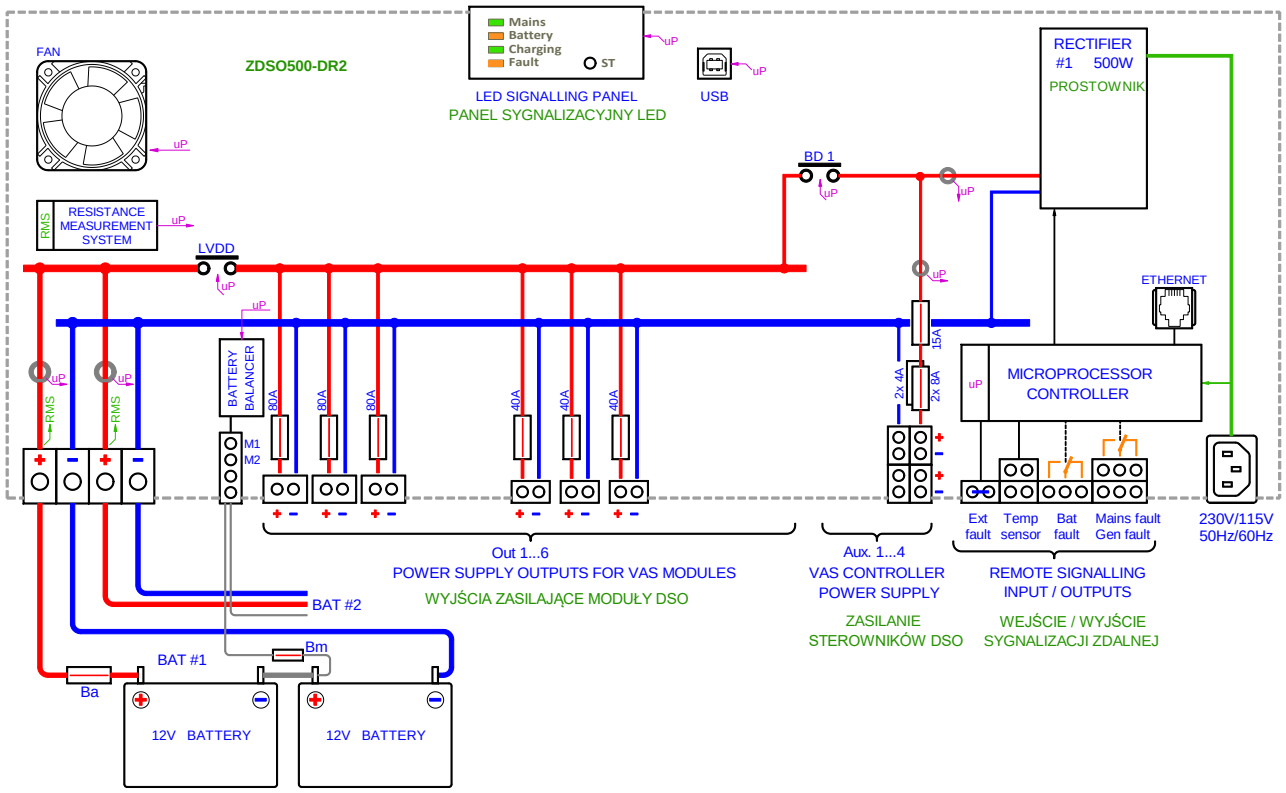


Fig. 4. Simplified diagram of ZDSO500-DR2 PSU

5. Cooperation with battery

The ZDSO500-DR PSU system allows to work with a batteries in one of two modes. Operation mode can only be selected using an external computer via a USB port. Floating mode is factory setting mode.

5.1. Floating mode.

Floating mode is the type of operation in which a mains rectifier connected in parallel with a battery bank simultaneously supplies the loads. In the event of a mains power failure, battery current can be drawn immediately.

With the mains supply present, the PSU's microprocessor controller controls the rectifier in such a way as to keep the battery after charging under a floating mode voltage appropriate to the battery type. If, in this system, mains power returns after a momentary loss of mains power supply and a partial discharge of the battery, the battery charging current can be high enough to trigger a so-called bulk charging. This is a limited current charging mode but with an increased final voltage.

If a temperature sensor is connected, both the floating mode voltage and the bulk charging voltage can be temperature-dependent. Detailed charging and floating mode parameters can be set digitally. In the absence of a temperature sensor, the floating voltage specific to operation at 25°C is maintained and bulk charging is not triggered.

5.2. Intermittent battery charging mode.

This is the type of operation in which the AC adapter directly supplies the loads and the battery is only included when it is charging. Once charged, the battery is disconnected but a special system allows it to be connected immediately, e.g. in the event of a mains power failure.

With the mains power supply present, the microprocessor controller controls the AC adapter in such a way that when the battery is charged and the **LVDD** is disconnected, the output voltage is always slightly higher than the current battery voltage. This ensures that the loads connected to the PSU are powered from the power adapter and not from batteries. This voltage, as the battery continues to self-discharge, is gradually reduced (it follows the battery voltage). This state lasts until the battery voltage drops below a

predetermined level, at which point the **LVDD** is activated and the supplementary charging process is triggered. Once this process is completed, **LVDD** is disconnected again and the cycle repeats.

Entering the intermittent battery charging mode (if such an operating mode has been declared) follows the completion of the bulk charging and the immediately following time-limited floating operation (approximately 48h). In the same way, each new operating cycle begins.

In the event of a mains power failure, when the AC adapter has switched off, a special sensor primarily activates **LVDD** within a few milliseconds. The observed transient voltage drop at the load supply outputs does not exceed 1V.

Intermittent battery charging extends battery life by reducing the time the current flows through the batteries. This reduces corrosion of the cell's positive electrodes and the loss of water contained in the electrolyte.

6. Operating modes of the PSU

6.1. Operation with current mains power supply

This is the basic operating mode, during which the **Aux** outputs of the PSU provide 24V power to the VAS components requiring continuous operation (controller, routers and others) and the battery bank is monitored according to the selected one of the two operating modes (see point 5.). This condition requires that the amplifiers connected to the **Out** outputs do not draw current from the ZDSO500-DR PSU but rely on their own mains power supply.

Attention.

If, in an already switched-on system, one of the amplifiers starts to draw current from the **Out** outputs as a result of a fault or disconnection of its individual mains power supply, this can lead to uncontrolled discharge of the battery bank despite correct operation of the PSU. Such a state may be signalled by the PSU as an error.

6.2. Battery operation.

Battery operation takes place in the event of a mains power failure, when the loads draw their current directly from the battery bank. The voltage at the outputs is slightly lower than the current battery voltage. This voltage drop is related to the design of the PSU's power components and the current power of the load. When the battery has been discharged to a certain, predetermined level, the **LVDD** disconnects the battery to protect it from damage by over-discharge. A return to normal operation is possible once mains power supply is restored.

In the absence of mains power supply, it is possible to start the PSU in battery operation mode by pressing the button **ST** on the front panel (so-called cold start). The button must be held down for ~5 seconds. This requires the battery bank to have a voltage above 22V. At lower voltages, such an attempt will be ineffective.

6.3. Charging

The way in which the battery banks are charged depends on the selected operating mode (see section 5.) In each situation, the maximum charging current depends on the size of the battery bank's capacity selected using the slide switch located on the back of the PSU near the mains socket.

In floating mode, the following charging occurs:

- charging at floating operation voltage:
  - continues whenever the charging current does not exceed the value that triggers accelerated charging;
- bulk charging (if enabled):
  - is triggered when the charging current exceeds a predetermined value for a specified time.

In intermittent battery charging operation mode, the following charging occurs:

- bulk charging with time-limited floating operation each time the operation mode is entered when the battery disconnected;
- supplementary charging, once the battery bank has reached a predetermined voltage during self-discharge.

Bulk or supplementary charging is switched off under normal conditions when the current drawn by the battery falls below a set level. Shutdown can also occur in emergency situations: if the preset permissible charging time is exceeded or if the battery temperature exceeds the permissible level. Charging is also terminated by the removal or failure of the temperature sensor.

7. Battery selection.

7.1. Required battery bank capacity.

This is the capacity specific to the VAS, determined by its design, the required holding time and the nature of the operation (the way the VAS broadcasts messages). It also takes into account the ageing of the battery bank. Its calculation is beyond the scope of this manual.

7.2. Maximum battery bank capacity in accordance with EN 54-4

The current drawn from the **Aux** outputs limits the available charging current of the battery bank and thus its capacity. This is due to the requirements of the EN 54-4 standard, which imposes a specific time of 24 hours to charge the battery to 80% of its nominal capacity. The current drawn from **Aux** outputs is the current available during charging and is referred to by this standard as Imax_a.

EN 54-4 also defines the Imax_b current as the maximum, short-term current that can be drawn when the battery bank is not required to be charged. For ZDSO500-DR2 and ZDSO500-DR3 PSUs, these will be the maximum currents that can be drawn from the **Aux** outputs at all, i.e. 15A and 2× 15A respectively (see section. 2).

To protect the battery from too high a charging current, which could lead to early wear and tear, ZDSO500-DR PSU allows it to be limited by selecting the capacity of the battery bank operating in the VAS by means of a slide switch available on the rear panel of the PSU. The selected size indicates the maximum capacity that the PSU can handle correctly. The available current drawn from **Aux** outputs is directly related to this capacity. This is shown in the Figure 5 below.

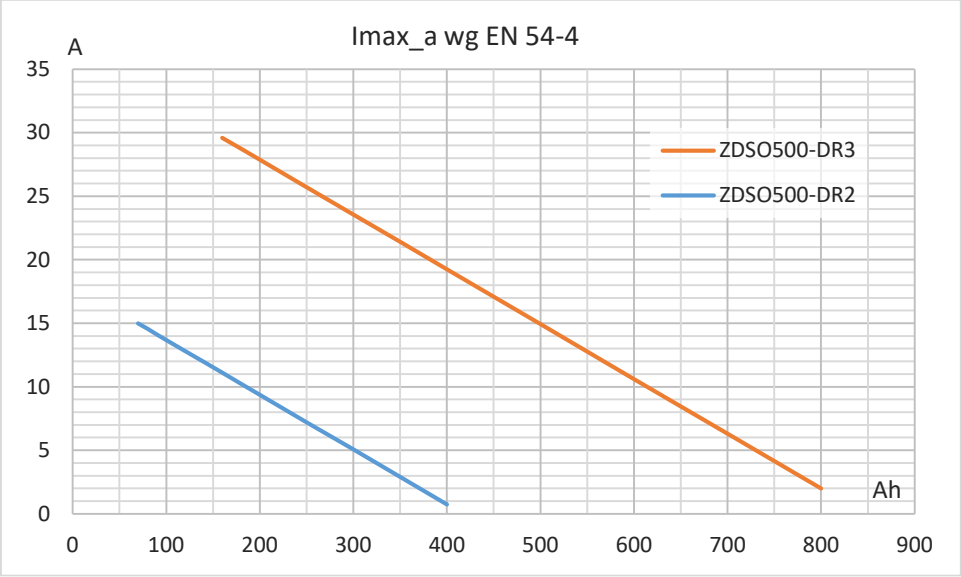


Fig.5. Maximum current that can be drawn from the **Aux** outputs (Imax_a) at a given battery bank capacity.

7.3. Maximum load on the battery bank in the VAS.

The required capacity of the battery bank in the VAS is determined by balancing the two currents taking into account the load times:

- current drawn continuously to supply power to control devices or to ensure communication in the VAS;
  This current is essentially the same, both with mains power supply present and during battery operation, and both in the absence and presence of state of alert, regardless of the power condition. In ZDSO500-DR PSUs, the **Aux** outputs are used for this purpose. The load level can vary from a fraction to tens of amperes (maximum 15A for ZDSO500-DR2 PSU and 30A for ZDSO500-DR3 PSU).

- current drawn from the battery bank by the audio power amplifiers in the absence of mains power supply during a fire alarm.
  In ZDSO500-DR PSUs, the **Out** outputs are used for this purpose. The load level can reach several hundred amperes (400A for ZDSO500-DR2 PSU and 600A for ZDSO500-DR3 PSU). The actual magnitude, in addition to the number and type of devices used in a given VAS, also depends on the nature of the means of alerting used: the level and duration of continuous signals and voice messages and the intervals between them.

The durations of individual loads can vary, depending on the fire scenario adopted. Typical quantities are: the current during 30 hours of supervision (battery operation, without mains power supply, but still before the alarm) and an alarm time of 30 min, together with its power at -3dB (i.e. 50%) of the maximum power of the audio power amplifiers in the VAS.

The calculation of the required capacity of the battery bank, due to the large number and variety of components, is beyond the scope of this manual. However, in any situation, the manufacturer of the ZDSO500-DR PSUs is there to help with these calculations.

Attention.

Once the required battery bank capacity for the VAS has been determined, it is necessary to check whether the required current at the **Aux** outputs is less than the Imax_a current permitted for the battery capacity in question by EN 54-4 (see section 7.2.).

7.4. Setting the size of the battery capacity.

Using the slide switch available on the back of the PSU, the size of the battery capacity that ZDSO500-DR PSU will work with can be set. For a detailed description of the use of the switch, see section 7.6

The choice of capacity influences the size of the maximum current with which the battery will be charged, which reduces the load on the PSU itself and, above all, reduces the heating of the battery bank. The capacity selected with the sliders should be close to the actual capacity size connected to ZDSO500-DR PSU. The range of settings is illustrated in the table below.

ZDSO500-DR2

Capacity selected using the sliders	100Ah	200Ah	300Ah	400Ah
Maximum charging current	4.4A	8.7A	13A	17.3A *)
Maximum capacity in the system	100Ah	200Ah	300Ah	400Ah *)
Minimum capacity in the system	26Ah	50Ah	75Ah	100Ah

**When supplied with 115V: 15A and 350Ah*

ZDSO500-DR3

Capacity selected using the sliders	200Ah	400Ah	600Ah	800Ah
Maximum charging current	8.7A	17.3A	25.9A	34.6A *)
Maximum capacity in the system	200Ah	400Ah	600Ah	800Ah *)
Minimum capacity in the system	50Ah	100Ah	150Ah	200Ah

**When supplied with 115V: 30A and 720Ah*

The quantities shown relate to the total battery capacity required for the VAS. If more than one battery string is used, this figure should be divided by the number of battery strings.

Attention.

The battery bank working together must be of the same type, same capacity and same state (degree of charge).

Example.

In the VAS, due to the number of power supply outputs for the acoustic power amplifiers, ZDSO500-DR2 PSU is envisaged. The required total capacity of the battery bank was determined from the energy balance of this system to be 395Ah with a current drawn from the **Aux** outputs of 8A. *The PSU allows 2 battery strings to be connected, so a single battery should have a capacity of 197.5Ah. The closest typical capacity is 200Ah. The system will thus have a total battery capacity of 400Ah. So, using the slide switch on the rear panel of the PSU, 400Ah would have to be selected.*

Based on the figure in section 7.2, it is now possible to determine the maximum allowable current that can be drawn from the ***Aux*** *outputs at 0.745A, this is well below the required level of 8A. This necessitates the use of ZDSO500-DR3 PSU. In this case, two batteries with a capacity of 200Ah each or three batteries with a typical capacity of 150Ah can be used as before.*

The allowable current from ***Aux*** *outputs will be 19.2A in the first case and 17A for the second solution, which more than covers the demand. For the first solution, use the slide switch to select 400Ah and for the second, 600Ah*.

7.5. Measurement of the resistance of the battery circuit.

ZDSO500-DR PSUs, due to the requirements of the EN 54-4 standard, have systems for measuring the resistance of the battery circuit, i.e. both the battery itself and other components of the circuit outside the PSU. These include fuses, connection cables, pin terminals, etc. Resistance measurement is not performed during battery operation and in situations where the battery bank is charging.

Using the slide switch located on the back of the PSU, next to the mains socket, the desired resistance value can be selected, beyond which a fault signal will be triggered. For a detailed description of the use of the switch, see section 7.6.

The value set should be related both to the resistance of the battery banks used (this is due to the capacity of the battery) and to the way the battery is connected (length and cross-section of the connection cables and the battery fuse used). However, the resistance value must not be set too high, as during a possible fire alarm, the consumption of a very high current from the battery bank by the amplifiers may cause the supply voltage to drop below the level allowed by the VAS.

By design, the battery circuit resistance measuring system should serve to detect a damaged or worn battery whose resistance has increased noticeably. Therefore, it is possible to relate the resistances of an efficient battery to the resistances of the connections. The dominant role should be played by the battery and not by other components in the circuit. It is recommend that the resistance of the connections (their length is double the distance between the battery and the PSU) be at least twice the resistance of a single 12V battery. The corresponding graph is shown below in Fig.6.

Example.

The system uses a 150Ah battery 1.5m away from the PSU (the length of the battery connections is 3 m). As the resistance of the 12V 150Ah storage battery is 3.5mΩ, the resistance of the connections should be less than 1.75mΩ. This condition is met by a 35mm^2 or 50mm^2 cable.

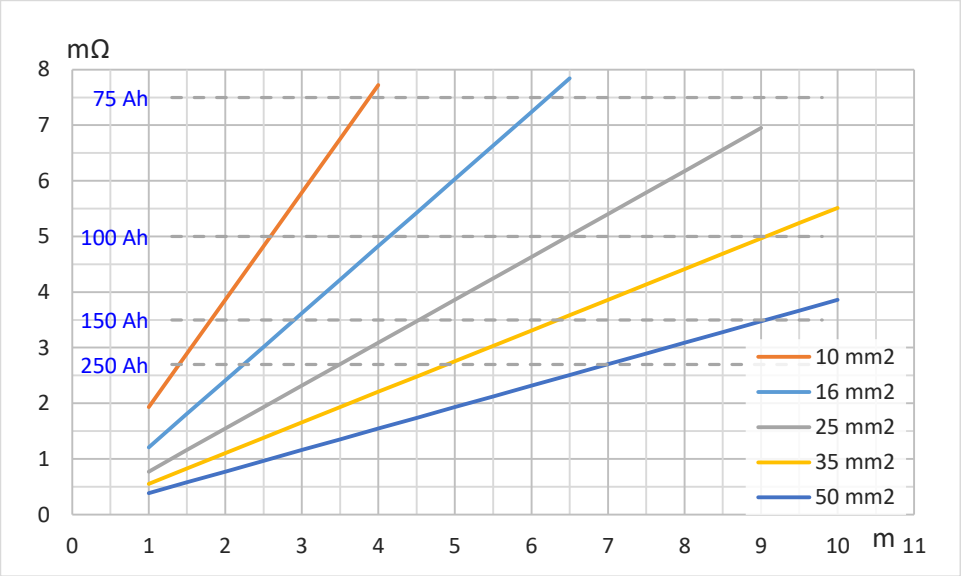


Fig. 7. Resistances of cables of different lengths and a given cross-sectional area against typical 12V battery resistances.

7.6. Selector switch for battery capacity and battery circuit resistance.

On the back of the PSU, next to the mains socket, there is a slide switch for selecting the capacity of the battery bank with which the ZDSO500-DR PSUs will work and for selecting the limiting resistance of the battery circuit. A brief description of the meaning of each switch position is provided next to the switch.

The minimum capacity size **Cap** is 100Ah for ZDSO500-DR2 PSU and 200Ah for ZDSO500-DR3 PSU, which by means of the next two sliders: 1. and 2. can be enlarged. The resulting capacity is the sum of the minimum volume and the values assigned to individual sliders set to the ON (raised) position. Hence, the maximum possible capacity setting is 400Ah and 800Ah, respectively.

<u>The selected capacity refers to the total capacity of the connected battery bank, regardless of the number of battery strings used.</u>

Selection of the battery capacity of ZDSO500-DR2 and ZDSO500-DR3 PSUs.

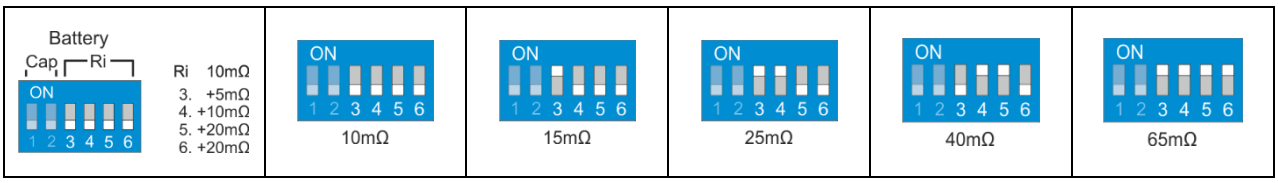
Battery Cap Ri ON 1 2 3 4 5 6 — ZDSO500-DR2 — Cap 100Ah — 1. +100Ah — 2. +200Ah	ON 1 2 3 4 5 6 — 100Ah	ON 1 2 3 4 5 6 — 200Ah	ON 1 2 3 4 5 6 — 300Ah	ON 1 2 3 4 5 6 — **400Ah**
Battery Cap Ri ON 1 2 3 4 5 6 — ZDSO500-DR3 — Cap 200Ah — 1. +200Ah — 2. +400Ah	ON 1 2 3 4 5 6 — 200Ah	ON 1 2 3 4 5 6 — 400Ah	ON 1 2 3 4 5 6 — 600Ah	ON 1 2 3 4 5 6 — 800Ah

The minimum resistance **Ri** is 10mΩ, which is achieved with four successive sliders: 3. 4. 5. and 6. can be enlarged. The resulting resistance is the sum of the magnitude of 10mΩ and the values assigned to the individual sliders set to the ON (raised) position. Therefore, the maximum value that can be set is 65mΩ.

Attention.

- The set resistance refers to the resistance of each, individual battery string.
- A change in the setting of the slide switch is immediately adopted for use, both in mains power supply and battery operation.

Selecting the limit resistance of a battery circuit – examples.



8. Installation and connection

8.1. Assembly

The PSU cassette is suitable for installation in a typical 19-inch rack. The use of guides to support the cassette is required, however, these must not cover the ventilation openings located on either side of the cassette (at least 8 cm ventilation space must be provided). The cassette front panel should be screwed to the rack stand using four M6 screws.

In order for a rack with a mounted VAS to meet the requirements of EN 54-4, it is sufficient for it to have an IP30 degree of protection.

8.2. Connection

The table below lists the connectors used in ZDSO500-DR PSU, together with their maximum load capacity and maximum cable cross-sections.

Comparison of ZDSO500-DR PSU connectors

Output type	Plug type	View	- DR2	-DR3
Mains power supply **230Vac .....**	IEC C13 1.5mm^2 10A *1)		1 pc.	1 pc.
75A **Out** outputs for powering amplifiers	PC 16/2-ST-10.16 16mm^2 76A		3 pcs.	5 pcs.
40A **Out** outputs for powering amplifiers	PC 5/2-STCL1-7.62 6mm^2 41A		3 pcs.	6 pcs.
Aux outputs for additional powering	FMC 1.5/2-ST-3.81 1.5mm^2 8A		4 pcs.	8 pcs.
M outputs of balancers	FMC 1.5/4-ST-3.81 1.5mm^2		1 pc.	1 pc.
Relay indication outputs **Bat fault**, **Gen fault** and **Mains fault**	FMC 1.5/3-ST-3.81 1.5mm^2		3 pcs.	3 pcs.
External fault indication input **Ext fault**	FMC 1.5/2-ST-3.81 1.5mm^2		1 pc.	1 pc.
Temperature sensor input **Temp sensor**	FMC 1.5/2-ST-3.81 *2)		2 pcs.	2 pcs.

**1) The mains plug and mains cable are not supplied as standard with the PSU. A suitable set can be ordered from the manufacturer of the PSU (see section 9.5.3.).*

**2) Plug pre-mounted on the temperature sensor cable. A custom-made temperature sensor can be ordered from the manufacturer of the PSU (see section 9.5.3.).*

8.3. Connection of the power grid

A 3-core 1.5mm^2 cable, terminated with an IEC C13 plug, should be used for connecting the PSU inside the rack in which the VAS is installed. As the PSU is not equipped with its own mains circuit breaker, a C10A overcurrent circuit breaker is required in the supply circuits.

The necessary installation should be in the form of a permanent installation equipped with appropriate fuses and a surge protection system. The application of a specific surge protection solution depends on the conditions of both the electrical installation used and the equipment operating in it. This is a task for a specialist who will propose a specific solution based on EN 62305 and PN-HD 60364. Effective protection will be a multi-stage system covering the entire VAS and not just the PSU.

8.4. Connection of VAS amplifiers

The high-current **Out** outputs are designed for connecting audio amplifiers with maximum power:

- for 75A **Out** outputs: 2000W each, with 16mm^2 cables
- for 40A **Out** outputs: 1000W each, with 6mm^2 cables

The indicated powers of the amplifiers are the maximum values of their output power. Due to the nature of the power consumption (transmission of voice messages or alarm signals together with the necessary interruptions), the actual average power consumed by the amplifiers is lower. Nonetheless, connections should be short and made using cables with the cross-sections indicated above so that, at times of full load, excessive voltage drops are not introduced, which could cause the amplifiers to malfunction or even shut down.

Attention.

If the main amplifier has its backup amplifier in the VAS, it is possible to connect both amplifiers to a common power output. However, this connection should be made outside the PSU connectors.

8.5. Connection of other VAS components

Those components of the VAS that require continuous power supply should be connected to the **Aux** outputs. It is recommended that connections be made with 1.0...1.5mm^2 cables.

Each **Aux** output is fitted with its own safety fuse. These outputs are grouped into sets (**Aux1**..**Aux4** for the ZDSO500-DR2 PSU and **Aux1..Aux4** and **Aux5..Aux8** for the ZDSO500-DR3 PSU). Each set has an additional common fuse that limits the total current that can be drawn from that set (see section 2).

Therefore, a fault on one output will not cause power supply interruption on the outputs of the others and, in the case of ZDSO500-DR3 PSU, an overload on one set of **Aux** outputs will not cause power supply interruption on the adjacent set.

8.6. Connection of the battery bank

The connection of the battery should be made with cables of the appropriate cross-section for the anticipated load. Cables with crimped eyelets having an 8mm hole are required. The maximum width of the eyelet must not exceed 20mm.

Attention.

ZDSO500-DR PSUs use a battery connector fitted with M8 pin terminals made of brass. The cable with the eyelet must be screwed on with a torque of 4...5Nm to ensure adequate electrical contact. The value of 6Nm should not be exceeded due to the possibility of terminal breakage.

This will ensure adequate pressure and, at the same time, will not lead to the breakage of pin.

Due to the requirements of EN 54-4 related to the maximum resistance of the battery circuit, the length of the connections may affect the cross-sectional area of the cables used (see section 7.4).

All bolted connections must be made securely. The connections should be as short as possible. The two cables connecting the battery and the PSU should be run close to each other (in parallel) so that they do not create unnecessary induction loops that can cause damage to the power supply system of the VAS in the event of short circuits in the power supply circuits.

The PSU is not equipped with a fuse for battery bank circuit and its design is based on a common negative bus. Therefore, a suitable fuse should be fitted in the immediate vicinity of the positive pole of the battery bank to protect against the effects of a possible short circuit (see Fig.3 and Fig.4 in section 4).

Attention.

- This fuse must be removed before connecting the battery terminals to the PSU. Activation of the fuse should be preceded by a thorough check of the polarity and quality of the connections
- Particular attention must be paid to the polarity of the battery to be connected and the battery terminals of the PSU. Reverse connection of the cables can cause serious damage to both the PSU itself and the external devices connected to it.

8.7. Connection of balancers.

A balancer socket located near the battery connector allows the midpoint of the battery (the point where two storage batteries in a given battery string are connected) to be connected to the special load system of the PSU. Its purpose is to equalize the voltages between batteries connected in series.

The connection should be made with a 0.75...1mm^2 cable, at the end of which a 0.63A fast safety fuse is fitted near the battery bank (see Fig.3 and Fig.4 in section 4.). Its purpose is to protect the made connection from accidental short circuit if the cable slips out of the balancer connector plug or is damaged.

The cables must first be connected to the plug and then to center points of the battery. It is safe to misconnect the cable to any pole of the battery bank.

For correct operation of balancers, it is not necessary to connect a specific output to the midpoint of a specific battery. If there is an error in operation, it can be read out digitally via a USB port and will be assigned to the balancer output number and not the battery string number.

The use of balancers is not mandatory. A suitable fuse holder can be ordered from the manufacturer of the PSU (see section 9.5.3).

8.8. Connection of external fault signal

The active state of the fault signal input is the state in which both contacts of the **Ext fault** connector are open. Therefore, when this input is not in use, the plug supplied with the PSU should be inserted into its socket with the pre-mounted jumper. The active state of the input is indicated by an LED located near the connector.

If the external fault signal is fed from outside the rack in which the VAS components are installed, this connection must be made with a pair of screened cables. The cable shield should be connected to the earthed structure of the rack. Therefore, it is best to use an intermediate element in the rack, such as single-circuit connectors on a TS-35 rail with an earthing terminal. In this case, no special requirements are imposed on the cable between this intermediate element and the **Ext fault** connector of the PSU.

Both the isolated contacts of an external relay and an opto-isolator can be used for the control of the **Ext fault** input. However, attention must be paid to the polarity and level of the electrical load being contributed by the input (see section 2).

Attention.

One of the contacts of the **Ext fault** connector is galvanically connected to the negative bus of the PSU and the battery (it has a special marking with an arrow and the sign **–**). It follows that any control circuits connected to it will also be connected to the negative bus of the PSU and battery.

8.9. Output for relay remote indication

The relay remote indication outputs are equipped with 3 field connectors providing all 3 relay contacts: NO, NC and C. They are galvanically isolated from the other circuits of the PSU.

If the remote indication is taken outside the rack in which the VAS components are installed, the connection of each of the outputs used should be made with a pair of screened cables. The cable shield should be connected to the earthed structure of the rack. Therefore, it is best to use an intermediate element in the rack, such as single-circuit connectors on a TS-35 rail with an earthing terminal. In this case, no special requirements are imposed on the cable between this intermediate element and the relay output connectors of the PSU.

8.10. Connection of temperature sensor

Two identical temperature sensors are supplied with the PSU. The sensor connected to input #1 (**TEMP SENSOR #1**) is used for the measurement of temperature of the battery banks, on which their operating voltage depends. The sensor should be placed between the top two storage batteries. It should be ensured that the sensor adheres tightly to one of the storage batteries, e.g. by immobilizing it with adhesive tape.

Failure of the temperature sensor, including its disconnection, will cause the PSU to switch to 25°C-specific operation. Bulk and supplementary charging will not be triggered either.

The sensor connected to input #2 (**TEMP SENSOR #2**) is used for the measurement of ambient temperature and has no direct influence on the operation of the PSU. It is used for the control of operating conditions of the VAS. The sensor should be mounted at the top of the rack stand in a place that is not exposed to direct heat or fan-induced air movement.

The sensors are fitted with their own plugs at the factory. Given that an element with a significant resistance has been used as a temperature sensor, if necessary in a specific installation, it is possible to shorten the sensor cable accordingly or extend it using intermediate elements, such as single-circuit connectors for the TS-35 rail. The sensors have no distinguished polarity.

9. Service

9.1. Introductory information

The output voltages as well as the signaling thresholds are set at the factory. It is possible to change these settings using an external computer and special software but this can only be done after consultation with the manufacturer. Ad hoc operational problems should not be solved by changing the operating parameters of the PSU.

ZDSO500-DR PSUs should be subjected to periodic technical inspections by the manufacturer's service department, or a body authorized by the manufacturer, at least once a year throughout their exploitation. Any work carried out by unauthorized persons, or failure to carry out periodic inspections, may result in the loss of the manufacturer's warranty and will transfer responsibility for the correct functioning of the PSU to the user. The execution of the inspection should be confirmed by an appropriate protocol according to the manufacturer's model.

It is also recommended that between inspections, during normal operation of the equipment, attention is paid to any electrical or mechanical damage, either to the PSU itself or to associated equipment, which could affect the operation of the entire set. Any comments or concerns arising from this should be brought to the attention of the manufacturer to assess their potential impact on further operation.

For technical and service issues and periodic inspections, please contact directly the MERAWEX Service Department or the manufacturer's authorized body.

ZDSO500-DR PSUs work with external battery banks, which should be tested periodically:

- once a quarter, the correct operation of the VAS should be checked when operating from a battery bank with the mains power supply disconnected;
- once a year, a battery bank capacity test should be carried out. If their capacity has fallen below 80% of the nominal capacity, it is imperative that the entire battery bank is replaced with a new one. It is also recommended that such a replacement be carried out every four years of the battery bank life.

Attention.

The obligation to carry out regular technical inspections of fire protection equipment results from the Regulation of the Ministry of Internal Affairs and Administration of 7 June 2010 on fire protection of buildings, other buildings and grounds (Dz.U./Journal of Laws/ no. 109, item 719, sec. 3.3).

9.2. Safety of use

ZDSO500-DR PSU is a Class I device according to EN 62368-1 intended for connection to a permanent single-phase installation with the use of a protective conductor in accordance with PN-HD 60364-4-41:2007 *Electrical installations in building structures.*

The metal enclosure of the PSU is connected to the protective terminal of the mains power supply cable, and the anti-interference filters used in the PSUs are equipped with capacitors that cause leakage current to appear in this cable.

All other circuits of the PSU are isolated from both the mains circuits and its enclosure (see table in section 2). Hence, if required by the system in question, it is possible to connect the negative bus to the enclosure of the rack in which the VAS is installed. It is best to make this connection visibly and with easy access to it from the negative terminal of the battery bank.

The remote indication relay contacts are completely isolated from all circuits (including output circuits).

The external fault signal input is located at the negative bus potential of the PSU and battery bank. The connection of this input should not duplicate the negative pole connections of the power supply to those components of the VAS that control it. This can lead to the flow of significant equalization currents and consequent damage to this input. The safest way to control it is via isolated relay contacts or via an opto-isolator.

9.3. Digital communication

The PSU has a USB communication connector on the front panel used as standard for service purposes. The service software allows diagnostics to be carried out by checking many of the PSU's operating parameters and changing its default settings. This output is galvanically isolated from all other circuits of the PSU.

The PSU can be optionally equipped with an Ethernet interface for TCP/IP network operation. It has an implementation of two simple service servers:

- http server for presenting the current status of the system in the form of web pages accessible from a web browser;
- ModbusTCP protocol server for monitoring and controlling the device.

Detailed information is available from the manufacturer of the PSU.

9.4. Operating status indication

The PSU is equipped with light indication and remote indication, the status of which is maintained until the condition that triggered it ceases (removal or disappearance of the cause).

A comparison between the LED and remote indication statuses is shown in the following tables.

LED light indication on the front panel.

DESCRIPTION	STATUS	DESCRIPTION OF AN INCIDENT
Mains green	lit	Normal operating status with mains power supply present.
	extinguished	No mains power supply or faulty rectifier.
Battery yellow	lit	Battery operation (no power supply or faulty rectifier).
	extinguished	Normal operation with mains power supply present.
Charging green	pulsates	Bulk or supplementary charging.
	lit	Charging during floating operation
	extinguished	Charging complete.
Fault yellow	lit	There is a failure in or outside the PSU *1).
	pulsates	Fault signal appeared on input **EXT FAULT** *2)
	extinguished	Normal operating status with mains power supply present – no fault signals.

1) The Fault LED lights up at the same time as relay* **GEN FAULT *is switched off (see below).*

2) If an internal fault occurs at the same time as an external fault signal, the LED* ***Fault* *will light up with steady light*.

LED indication on the rear panel. All the LEDs are yellow.

DESCRIPTION	STATUS	DESCRIPTION OF AN INCIDENT
Each output **OUT**	lit	Defective fuse for an output in question
	extinguished	Output available.
Each output **AUX**	lit	Defective fuse for an output in question
	extinguished	Output on.
Output **EXT FAULT**	lit	External alarm input open (fault)
	extinguished	External alarm input closed (normal operation)

Relay remote indication.

DESCRIPTION	STATUS	DESCRIPTION OF AN INCIDENT
MAINS FAULT	on	Normal operating status with mains power supply present.
	disabled	No mains power supply or faulty rectifier.
BAT FAULT	on	Correct battery status.
	disabled	No battery, high resistance of the battery circuit or battery voltage below the set level (discharged battery).
GEN FAULT	on	No damage
	disabled	The presence of a fault in or outside the PSU. *)

*) *The failure of the fuses of* **OUT** *and* **AUX** *outputs and the external fault inserted at the* **EXT FAULT** input are also signalled. In addition, during power supply interruption, the **GEN FAULT** relay switches off when the power supply interruption lasts longer than 5 seconds.

On the rear panel of the PSU, near **MAINS FAULT** connector, there is the contact arrangement which applies to each of the signalling outputs in a state in which the relay is not energized (de-energized state). When the PSU is operating correctly and there are no faults, all relays are switched on.

9.5. Maintenance

The device requires no special maintenance. During normal operation, the only thing to be done is to ensure that the surroundings of the PSU are kept reasonably clean.

9.6. Service

9.6.1. Repairs to the PSU.

Any repairs to the PSU, whether under warranty or out of warranty, may only be carried out by the manufacturer or a service partner authorized by the manufacturer.

The only components that can be replaced by an unauthorized service center are the fuses accessible by unscrewing the top cover of the PSU. These fuses cover the **Out** and **Aux** outputs.

As the cause of a blown fuse can only be a short circuit that has occurred outside the PSU, it is imperative to recognize the cause of the short circuit and remove it before replacing the fuse. If a fuse blows again after it has been replaced, this should result in a call to an authorized service center for the VAS or to the manufacturer of the rack in which the system has been installed.

Output type	Manufacturer	Type	Value
75A **Out** outputs for powering amplifiers	Littelfuse	BF1 32V	80A
40A **Out** outputs for powering amplifiers	Littelfuse	BF1 32V	40A
8A **Aux** outputs for additional powering	Littelfuse	MINI 32V	10A
4A **Aux** outputs for additional powering	Littelfuse	MINI 32V	4A
Common fuse for a set of 4 **Aux** outputs	Littelfuse	MINI 32V	15A

Attention.

It is not permissible to use fuses of other types and values than those indicated above.

9.6.2. Quick operation test.

On the rear panel of the PSU, near the slide switch, there is an **SRV** button for two quick tests:

- a short press of the button starts the measurement of the resistance of the battery circuits;
- holding the button down for 10s changes the status of all signalling relays.

9.6.3. Additional equipment.

Accessories can be ordered from the manufacturer of the PSU to facilitate the installation of the PSU in a particular VAS. These are:

- mains cable of selected length with fitted IEC C13 plug;
- for balancers: fuse holder fitted with a 0.63AF fuse with connecting cables of a selected length and fitted eyelet terminals to connect the battery leads;
- a complete temperature sensor of the required length.

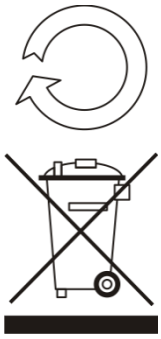
9.7. Additional information

The manufacturer reserves the right to make design and technological changes that do not impair the quality of the product.

10. CE marking

CE 1438
MERAWEX Sp. z o.o. ul. Toruńska 8, 44-122 Gliwice, Poland 23 1438-CPR-0922
EN 54-4:1997 + AC:1999 + A1:2002 + A2:2006 Power supply unit for Voice Alarm Systems PSU for Voice Alarm Systems ZDSO500-DR2, ZDSO500-DR3 DWU / DoP **:** DWU-MX-21 Other technical data: see operating manual

11. Handling of packaging and end-of-life products



The packaging of the product is made of non-hazardous materials (wood, paper, cardboard, plastics) that can be recycled. Unnecessary packaging should be returned to the recipient of waste after waste sorting.

The end-of-life product is non-hazardous waste, which should not be disposed of in the general municipal waste container but should be handed over to the local recipient of waste electrical and electronic equipment.

Proper handling of waste electrical equipment will help to avoid harmful effects on human health and the environment resulting from improper storage and treatment of such equipment.